NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION

# NASA Earth Science Data Systems (ESDS) Software Reuse Working Group

Robert Wolfe (NASA GSFC), co-chair

Asset Repository and CM Strike Team Workshop

Feb. 21, 2006

# Reuse Working Group (WG) Mission / Objectives

- Drive down the cost and time of system development, and reduce/eliminate unnecessary duplication of effort
- Increase flexibility and responsiveness relative to Earth science community needs and technological opportunities
- Increase effective and accountable community participation

# Reuse WG Charter Highlights

- Purpose
  - Address issues required to enable and facilitate reuse of software assets within NASA Earth Science Enterprise (ESE)
- Goals
  - Demonstrate the feasibility and value of reuse
  - Increase the supply and availability of reusable assets
  - Make recognizable and easy-to evaluate candidate reuse solutions
  - Minimize the cost of infrastructure activities to support the community's reuse activities
  - Increase community capacity and interest in reusing existing assets
  - Contribute to the removal of existing barriers to reuse
  - Recommend incentives to encourage reuse
- Scope
  - Facilitating reuse across projects without interfering with local control of participating systems
  - Focusing on reuse of existing assets
  - Reusability of newly developed assets
  - Focusing not only of software code but also on design artifacts (architecture, design, ICDs, test plans, etc.)
  - Focusing on reuse of proven operational and NASA-ESE specific software assets

# Reuse WG Activities

**Reuse Implementation Projects**
Efforts that result in the publication or use of a reusable component

**Reuse Incentive Activities**
Awards and structural changes that directly or indirectly encourage reuse

**Outreach and Education Activities**
Efforts that increase community awareness and understanding of benefits, best practices, etc

**Support/Enablement Activities**
Efforts that provide tools and mechanisms to enable reuse

**Policy Change Activities**
Efforts to reduce policy barriers to reuse

- Examples of work in some of these areas include:
  - Creating a web site to promote and provide information about reuse
  - Recommending that NASA create a *Reuse Enablement System (repository) for Earth science reusable software assets*
  - Providing policy recommendations to NASA to help encourage reuse

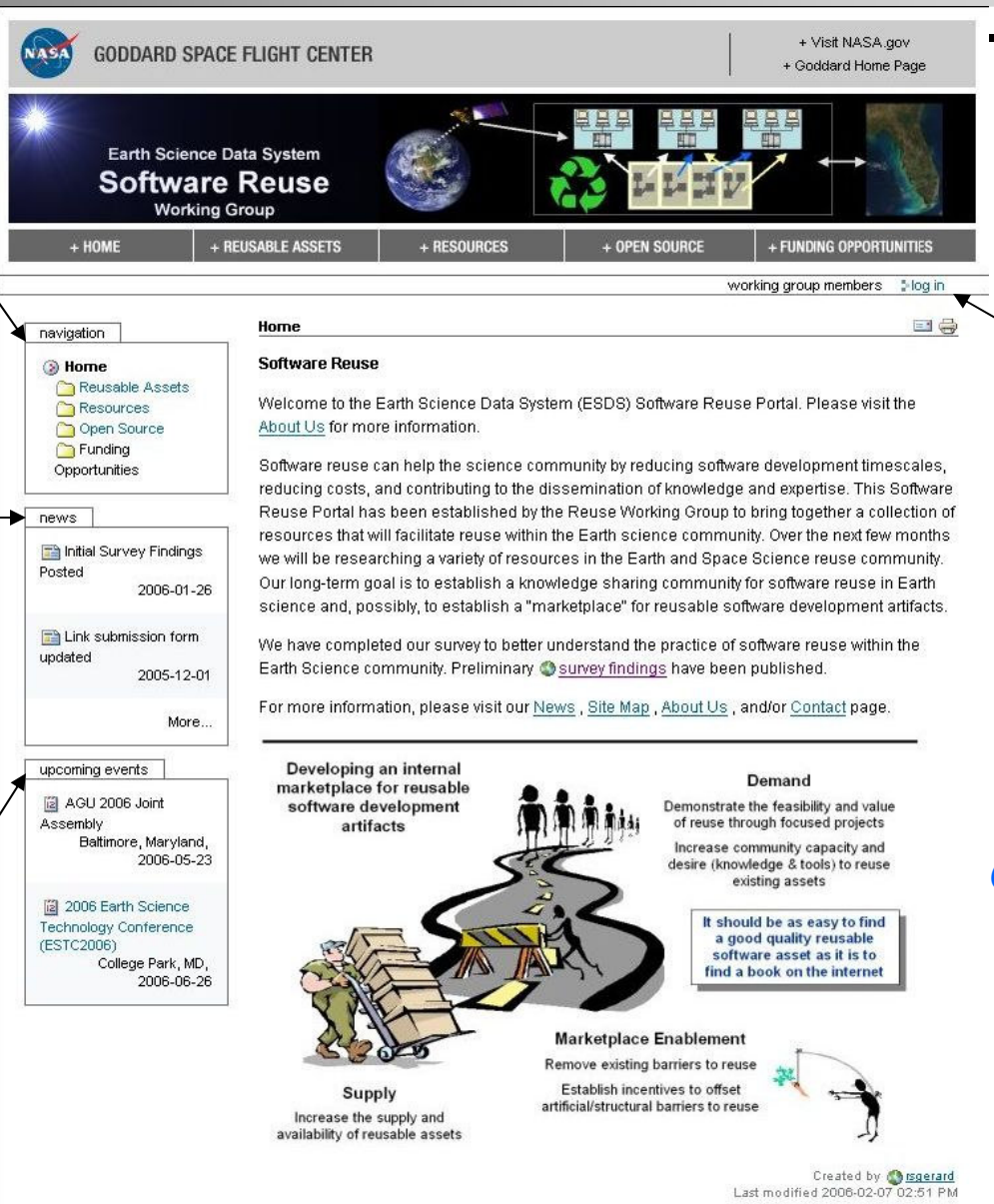
# http://softwarereuse.nasa.gov/

Navigation bar and tree

Recent news items

Upcoming events related to Earth science and/or software reuse

Log in for WG members maintaining the site




*Goal is to become a central location for information about software reuse.*

# Reuse Surveys

- A survey on the reuse practices of the Earth science community was conducted in 2004; results showed that:
  - Developers need to be able to easily locate and evaluate available reusable artifacts.
  - A catalog or repository for reusable artifacts is one of the best means of increasing software reuse within the community.
- In addition, the survey was repeated in 2005, with OMB approval (01/04/2005, Approval Number 2700-0117):
  - More diverse set of respondents (included non-government)
  - Received 100 responses from ~3000 invitations to participate
  - Basic results are the same as the 2004 survey
    - Main reasons for not reusing existing artifacts were not knowing that they existed and/or not knowing where to look for them
    - Catalog/repository rated as the best means of increasing reuse

# Reuse Enablement System (RES)

- Reuse Working Group recommended the establishment of a reuse catalog/repository subject to the findings of a technology evaluation / architecture study.
- A Reuse Enablement System is a combination catalog/repository that helps users find and obtain reusable software assets suitable for their needs.
- A trade study was conducted, evaluating a variety of sites on their ability to function as a software reuse enablement system for Earth science software developers.

# Requirements Background

- Primary users of a Reuse Enablement System are NASA-funded software developers within the Earth science community who create software products.
- The Reuse Working Group collaborated for several months in 2004 to identify the important functional requirements needed for such a system.
- Requirements fall into a number of areas including:
  - General
  - Asset Usage
  - Asset Submission
  - Content Management
  - System Administration

# System Requirements (1)

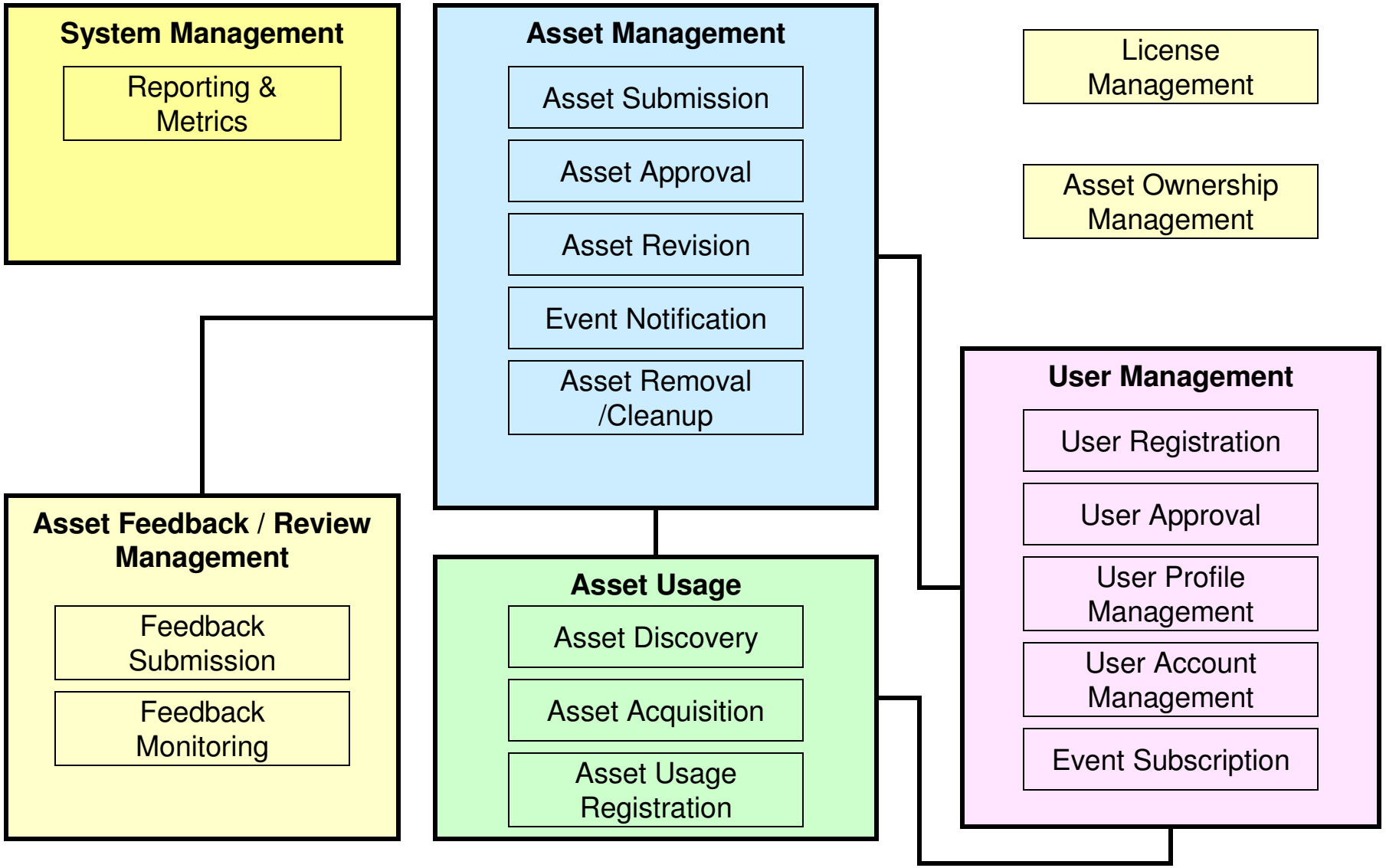
- Specific functional requirements identified from use cases for the system include:
  - Register User (in classes, e.g., Consumer or Provider)
  - Contribute/Update Assets (Providers can submit assets)
  - System Feedback (provided by the users)
  - Automatic Notifications (e.g., for new versions of an asset)
  - Discovering Assets (e.g., by search, hierarchy, list)
  - Register Asset Usage (to indicate active usage of the asset)
  - Asset Review (can include ratings)
  - Monitoring Feedback (both system and asset)
  - Workflow Management (e.g., reviewing asset submissions)
  - Capture Asset Needs (determine what users want, but can't find)
  - Catalog or Repository (list or store assets)

# System Requirements (2)

- Additional functional requirements include:
  - Minimal Operation Support (highly automated saves time/money by requiring less human support)
  - Performance (includes Section 508 compliance)
  - Security (e.g., of collected information, or for login passwords)
  - Technology (use appropriate mix of standard hardware and software for an easily maintainable system)

- Important non-functional requirements include:
  - Domain (Earth science focus)
  - Type of assets provided (small-sized components)

# Relationship of Requirements



# NASA Systems Reviewed for RES Trade Study

- NASA sites reviewed:
  - Global Change Master Directory (GCMD)
    http://gcmd.gsfc.nasa.gov/
  - Goddard Space Flight Center (GSFC) Open Source Software
    http://techtransfer.gsfc.nasa.gov/software.html
  - Ames Research Center Open Source Software
    http://opensource.arc.nasa.gov/
  - HDF-EOS Tools and Information Center [currently unavailable]
  - Computational Technologies (CT) Project
    http://ct.gsfc.nasa.gov/software.html
  - Earth Observing System Clearinghouse (ECHO)
    http://www.echo.eos.nasa.gov/
  - Planetary Data Systems (PDS) Software Download
    http://pds.jpl.nasa.gov/tools/software_download.cfm

# Non-NASA Systems Reviewed

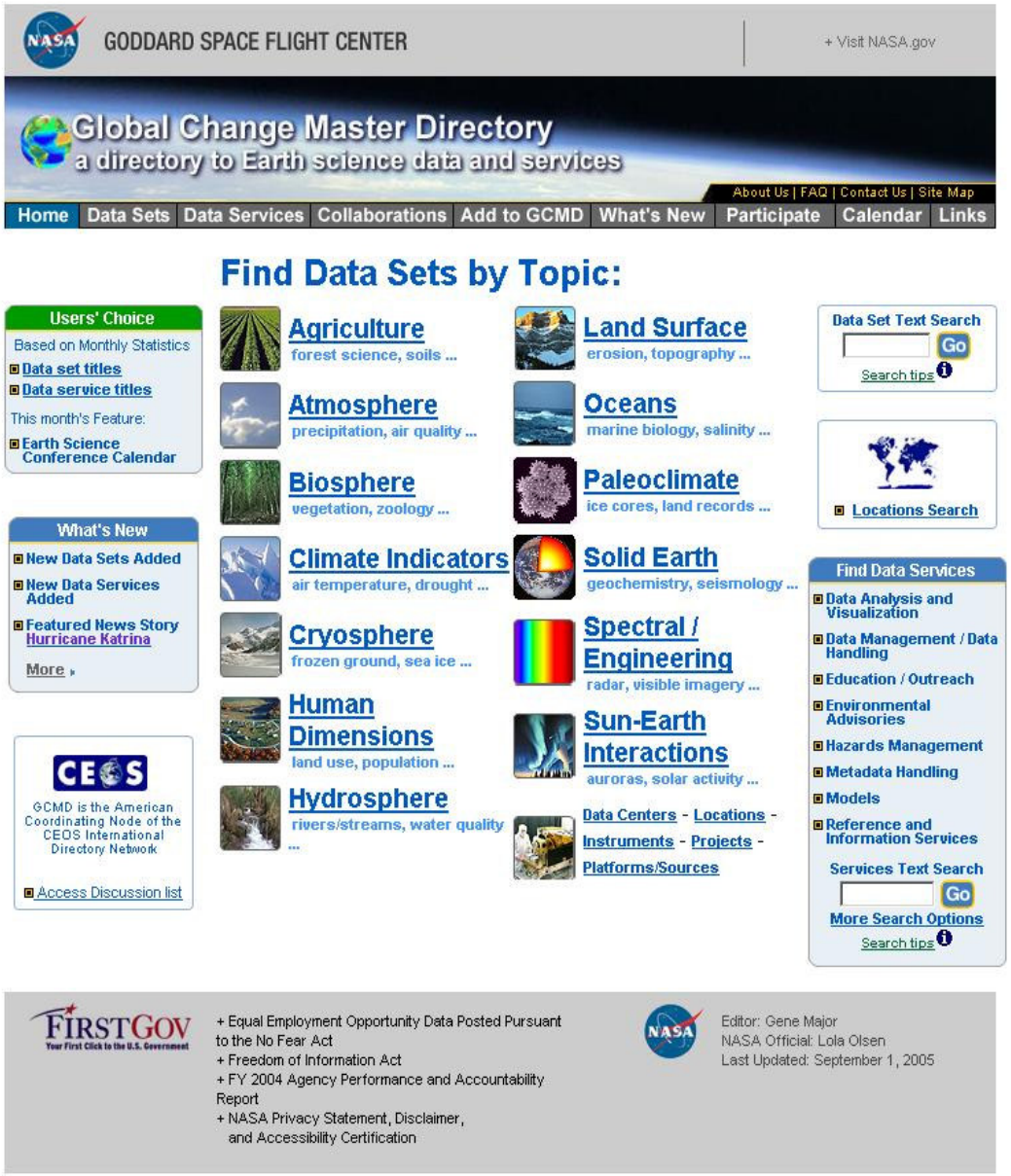
- Non-NASA sites reviewed:
  - Open Channel Foundation, hosts NASA's COSMIC Collection (http://www.openchannelfoundation.org/cosmic/)
  - SourceForge (http://www.sourceforge.net/)
  - Freshmeat (http://freshmeat.net/)
  - Scientific Applications on Linux (http://sal.jyu.fi/)
  - National Technology Transfer Center (http://www.nttc.edu/)
  - National HPCC Software Exchange (http://rib.cs.utk.edu/catalog.pl?rh=226)
  - Netlib (http://www.netlib.org/)
  - Savannah (http://savannah.gnu.org/)
  - Space Telescope Science Institute (STScI) Software and Hardware Products (http://www.stsci.edu/resources/software_hardware)
  - Astronomical Software and Documentation Service (http://asds.stsci.edu/)

# Other Systems Inspected

- NASA sites:
  - Direct Readout Laboratory (http://directreadout.nasa.gov/)
  - Glenn Research Center Software Repository (https://technology.grc.nasa.gov/software/cat_list.asp?Center=GRC)
- Non-NASA sites:
  - ArcScripts (http://arcscripts.esri.com/)
  - Wikipedia (http://www.wikipedia.org/)
  - Usenet newsgroups (e.g., http://groups.google.com/)
  - Ruby Application Archive (http://raa.ruby-lang.org/)
  - SciRuby (http://sciruby.codeforpeople.com/)
  - Comprehensive Perl Archive Network (http://www.cpan.org/)
  - FreeGIS (http://www.freegis.org/)

In general, these sites were too narrowly focused to warrant a detailed review.

# Global Change Master Directory (GCMD)
## http://gcmd.gsfc.nasa.gov/




- Domain is Earth science
- Type of assets provided are metadata about data sets (~16000) and, to a lesser extent, data services (~1240); in general, software is not provided
- Catalog of metadata
- Operational support is from a staff of ten members which includes four developers
- System technology includes Zope, CVS, Java, etc.
- Target audience is data users

# GCMD Data Set Page

GODDARD SPACE FLIGHT CENTER | + Visit NASA.gov

Global Change Master Directory
a directory to Earth science data and services

About Us | FAQ | Contact Us | Site Map

Home | Data Sets | Data Services | Collaborations | Add to GCMD | What's New | Participate | Calendar | Links

- Agriculture
- Atmosphere
- Biosphere
- Climate Indicators
- Cryosphere
- Human Dimensions
- Hydrosphere
- Land Surface
- Oceans
- Paleoclimate
- Solid Earth
- Spectral/Engineering
- Sun-Earth Interactions

- Data Centers
- Locations
- Instruments
- Platforms/Sources
- Projects

- Geospatial One Stop Projects

- Free text Search

- Help Center
- Questions?

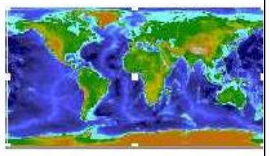
Parameters>BIOSPHERE>ANIMAL TAXONOMY>MAMMALS

Brief Record | Distribution | Attributes | Coverage | Personnel | Full Record | Update Record

## Mammal Species of the World

### Geographic Coverage

**Southernmost Latitude:** -90.0
**Westernmost Longitude:** -180.0
**Northernmost Latitude:** 90.0
**Easternmost Longitude:** 180.0



### Summary

2005-08-12

The Mammal Species of the World (MSW) is a database of mammalian taxonomy. The names are organized in a hierarchy that includes Order, Family, Subfamily, Genus and Species. Records include the following fields: Scientific name, Author's name, and Year described, Original publication citation, Original name, Common name, Type species, Type locality, Distribution, Comments, Status. MSW contains the names of 4,629 currently recognized species of mammals. The data is from the book by Wilson, D. E., and D. M. Reeder (eds), 1993.

The list was compiled by an international team of contributors. It can be used as an on-line reference for identifying or verifying recognized scientific names and for taxonomic research; or adapted as an authority file for collections management activities of mammal collections.

Questions?

Information was obtained from http://bubl.ac.uk/link/t/taxonomy.htm and from http://www.nmnh.si.edu/msw/.

### Data Center

**Data Center Name:** SI/NMNH >National Museum of Natural History, Smithsonian Institution
**Data Center URL:** http://www.nmnh.si.edu
**Dataset ID:** MSW

#### Personnel

**Name:** DON E. WILSON
**Email:** wilson.don at nmnh.si.edu
**Contact Address:**
National Museum of Natural History
Office of Biodiversity Programs
Smithsonian Institution
**City:** Washington
**Province or State:** DC
**Country:** USA

### Data Set Citation

**Dataset Creator:** Smithsonian Institution
**Dataset Title:** Mammal Species of the World
**Dataset Release Date:** 1993
**Dataset Release Place:** Washington, D.C.
**Dataset Publisher:** Smithsonian Institution
**Online Resource:** http://www.nmnh.si.edu/msw/

### Related URL

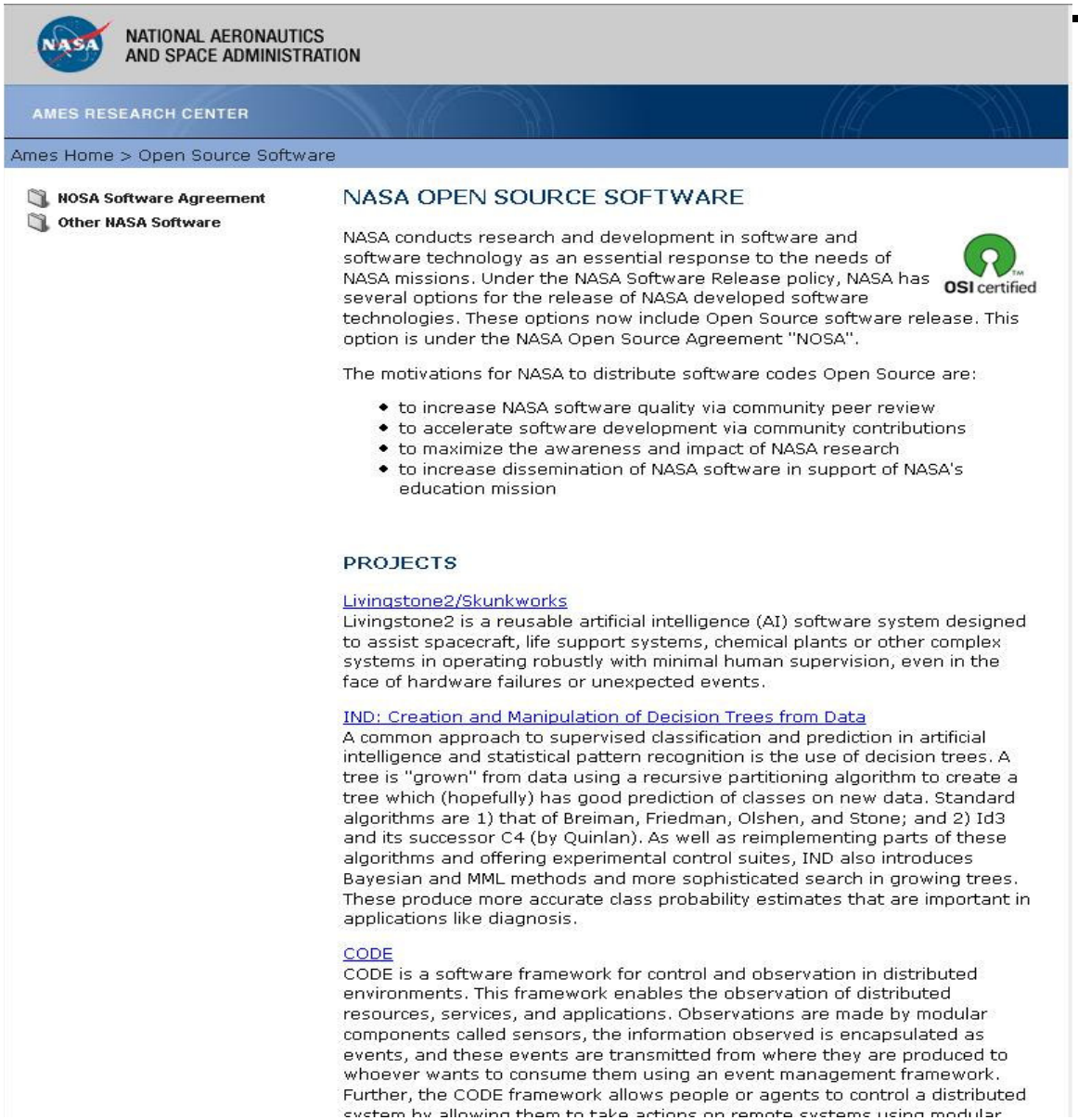
**Content Type:** BDP METADATA
**URL:** http://metadata.nbii.gov
**Description:**
Metadata in Biological Data Profile format.

FIRSTGOV Your First Click to the U.S. Government

+ Equal Employment Opportunity Data Posted Pursuant to the No Fear Act
+ Freedom of Information Act
+ FY 2004 Agency Performance and Accountability Report
+ NASA Privacy Statement, Disclaimer, and Accessibility Certification

Editor:Gene Major
NASA Official: Lola Olsen
Last Updated: September 1, 2005

# Ames Open Source Software Site
## http://opensource.arc.nasa.gov/




- Domain is general science
- Type of assets provided are open source packages produced by NASA (11 finished products)
- Acts as both a repository and a catalog
- Operational support is presumed to be small
- System technology is JavaServer web pages
- Target audience is software developers and users

NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION
ESDS Reuse Working Group

# Ames Open Source Project Page

AMES RESEARCH CENTER

Ames Home > Open Source Software

- NOSA Software Agreement
- Other NASA Software

## WORLD WIND

[ Project Home Page ] [ Software ]

World Wind allows any user to zoom from satellite altitude into any place on Earth, leveraging high resolution LandSat imagery and SRTM elevation data to experience Earth in visually rich 3D, just as if they were really there.

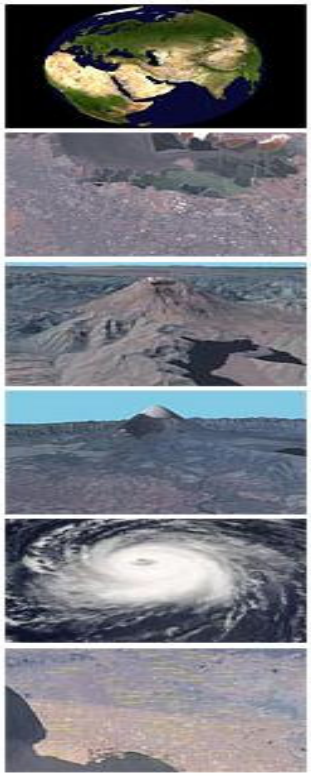
Particular focus was put into the ease of usability so people of all ages can enjoy World Wind. All one needs to control World Wind is a two button mouse. Additional guides and features can be accessed though a simplified menu. Navigation is automated with single clicks of a mouse as well as the ability to type in any location and automatically zoom into it.

The World Wind install package is all you need to get started. It contains all the other requirements such as the .NET runtime and managed DirectX library. Just download the ZIP file, extract and run the setup program.

World Wind can display a combination of data from a variety of sources...
Blue Marble – A full true color Earth as seen on NASA's Earth Observatory
LandSat 7 – An extremely detailed mosaic of imagery that's detailed enough to see freeways, stadiums, anywhere on the Earth.
SRTM – Elevation data gives rise to mountains, volcanoes, hills, and valleys.
Animated Earth – A collection of Earth science data set in motion. See how hurricanes move and fires spread.
GLOBE – See temperature, rainfall, and more across the entire globe.
Country & State borders – See outlines directly on the Earth as they trace rivers, mountain ridges, or latitude & longitude lines.

For a thorough list of features, user manual, key chart, screenshots and more, please visit http://learn.arc.nasa.gov/worldwind/

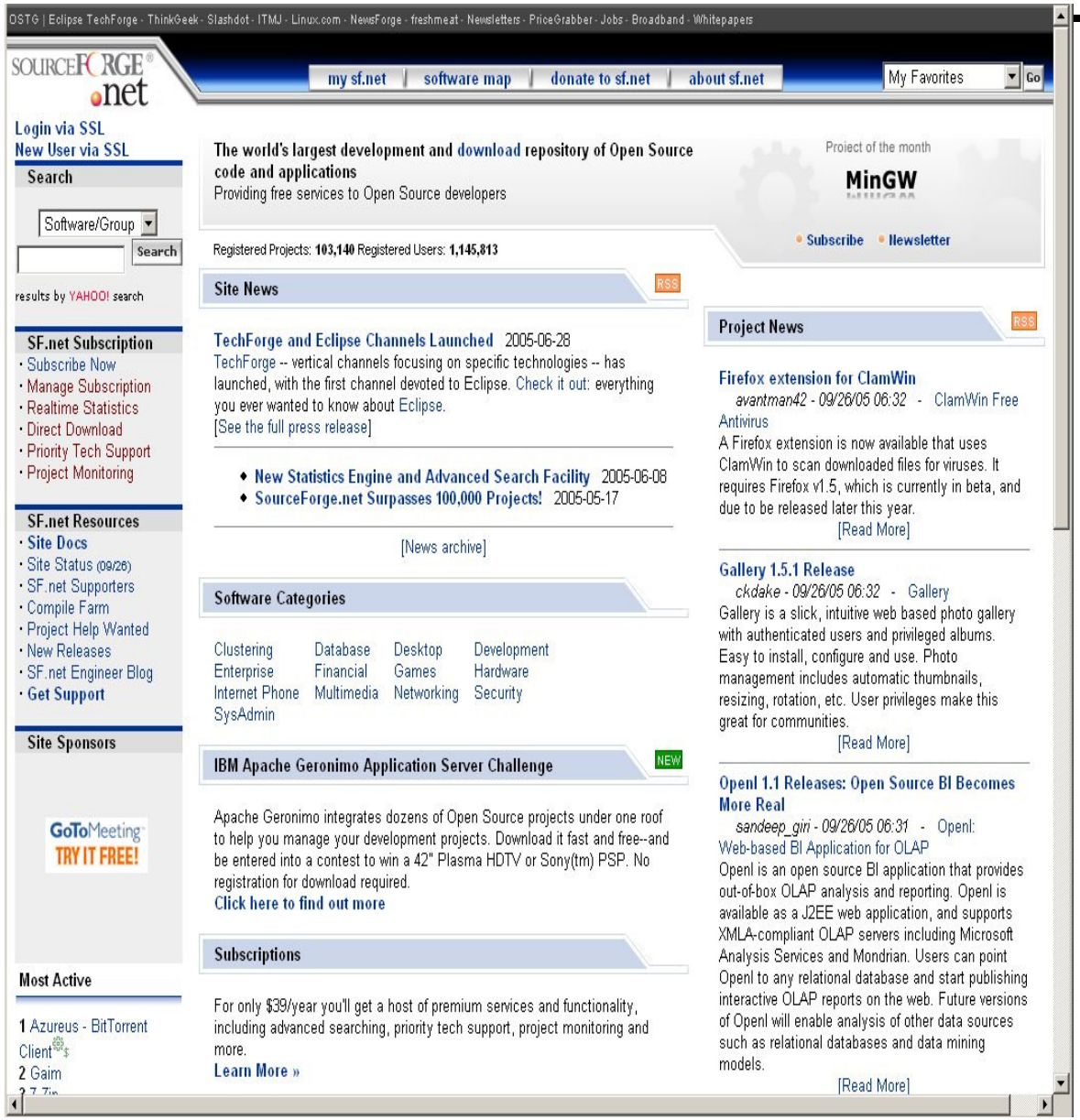
SCREENSHOTS



## SOFTWARE PACKAGES

**World Wind** 1.3
The WorldWind virtual globe application and the independent components used to implement it.
Download Page

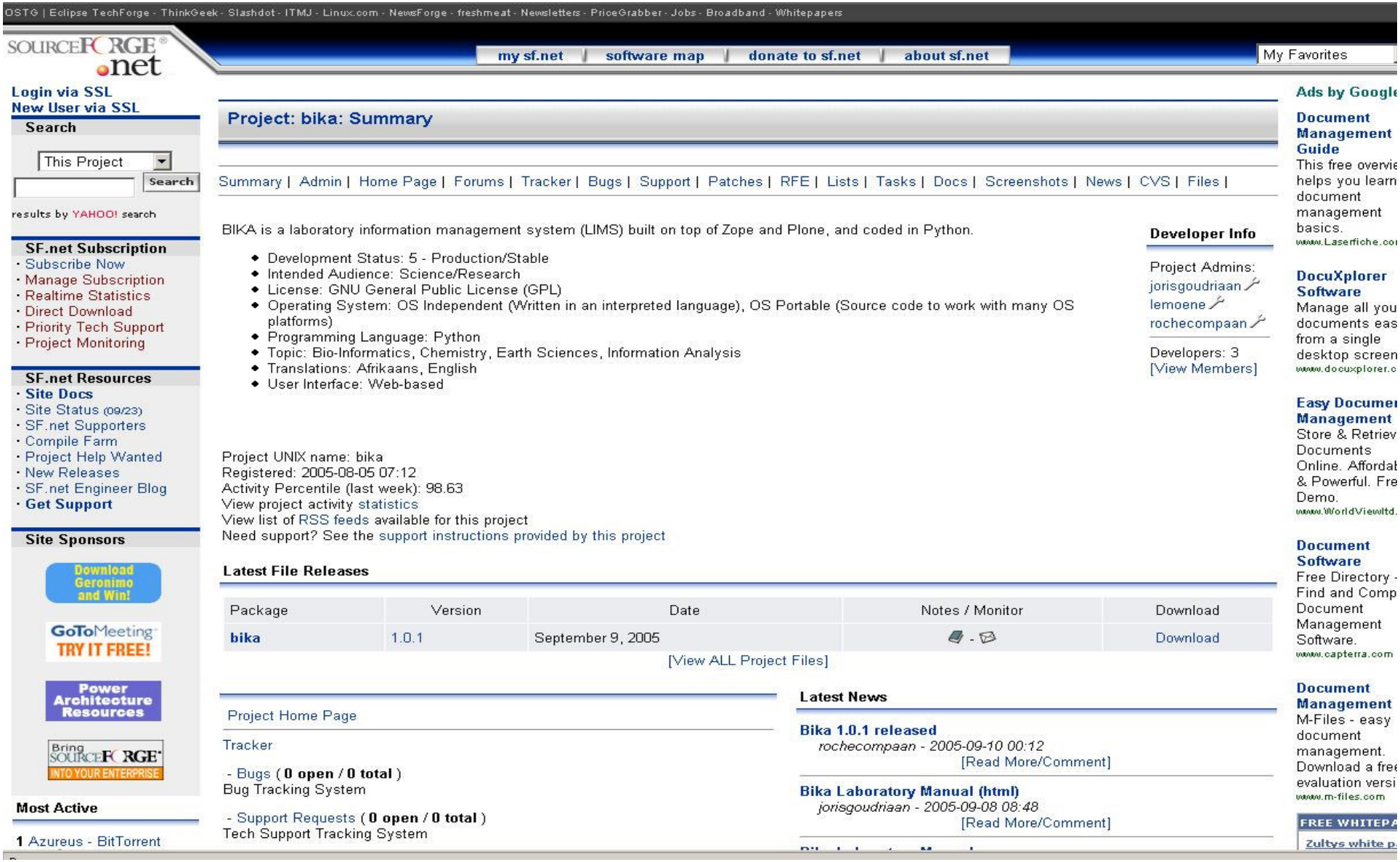
# SourceForge Site
## http://www.sourceforge.net/




- Domain is general software
- Type of assets provided are open source packages (approximately 102000 final products, not small components)
- Repository
- Operational support is from eleven full-time staff members
- System technology is PHP web pages
- Target audience is software developers and users

NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION
ESDS Reuse Working Group

# SourceForge Project Page



# NASA Systems Summary

| ***Requirement / Feature*** | ***Global Change Master Directory (GCMD)*** | ***GSFC Open Source Site*** | ***Ames Open Source Site*** | ***HDF-EOS Tools and Information Center*** | ***Computational Technologies Project*** | ***Earth Observing System Clearinghouse (ECHO)*** | ***Planetary Data Systems Software Download*** |
|---|---|---|---|---|---|---|---|
| Domain | Earth science | Earth and space science | General science | Earth science, HDF/HDF-EOS | Earth and space science | Earth science | Planetary astronomy |
| Type of Assets | Data sets, data services | Open source packages | Open source packages | Applications | Applications and source code | Metadata | Tools, binaries and source |
| Register User | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ★☆☆ | ☆☆☆ |
| Contribute/Update Assets | ★★☆ | ★☆☆ | ★☆☆ | ☆☆☆ | ☆☆☆ | ★★☆ | ☆☆☆ |
| System Feedback | ★★☆ | ★★☆ | ★★☆ | ☆☆☆ | ★★☆ | ★★☆ | ★★☆ |
| Automatic Notifications | ★★★ | ★☆☆ | ★☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ |
| Discovering Assets | Hierarchy, Search | List | List | List, Filter | Hierarchy | Search | List |
| Register Asset Usage | ☆☆☆ | ★★★ | ★★★ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ |
| Provide Asset Review | ☆☆☆ | ★☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ |
| Monitoring Feedback | ★☆☆ | ★★☆ | ★☆☆ | ☆☆☆ | ★☆☆ | ★☆☆ | ★☆☆ |
| Secure Log In / Registration | N/A | NO | NO | NO | N/A | YES | N/A |
| Catalog or Repository | Catalog | Both | Both | Repository | Catalog | Catalog | Both |
| Operation Support | Large | Small | Small | Inactive | Small | Available | Small |
| Technology | RSYNC, Zope, CVS, Linux, Java, JavaServer Pages, XML, Apache, Oracle/PostgreSQL, Struts, Lucene, XSLT, Dreamweaver | PHP | JavaServer Pages | Cold Fusion | HTML | XML (WSDL), SOAP, UDDI | Cold Fusion |

Legend:
No functionality = 0 stars
Some functionality = 1-2 stars
Full functionality = 3 stars

# Non-NASA Systems Summary

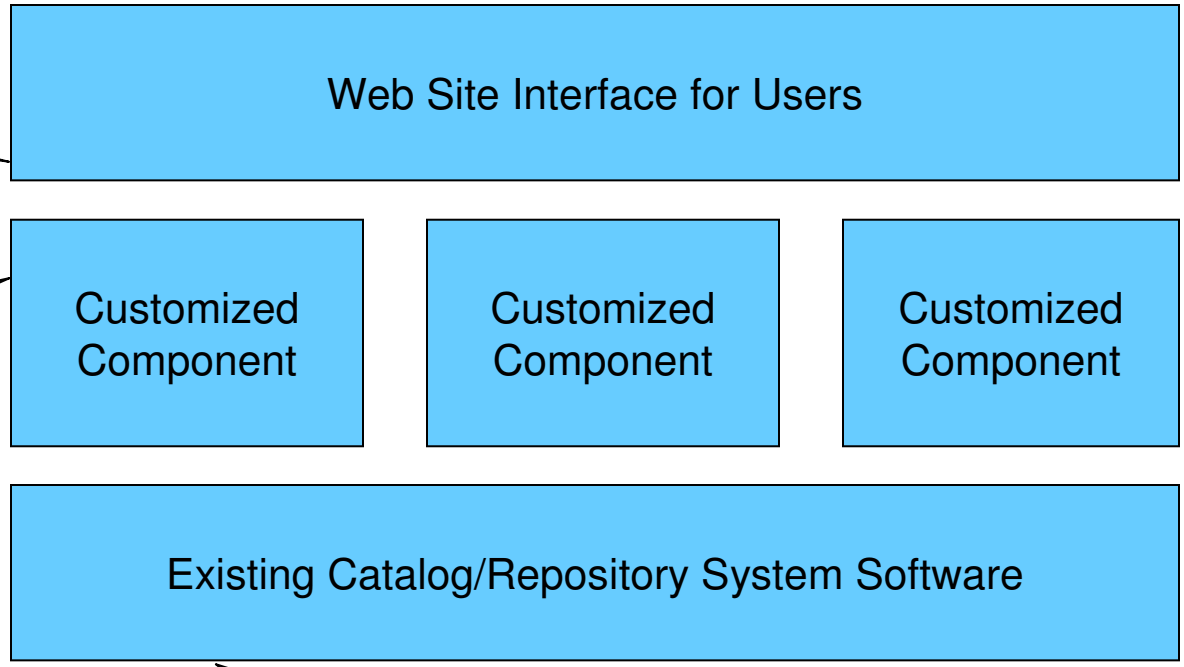
| *Requirement / Feature* | *Open Channel Foundation / COSMIC* | *SourceForge* | *Freshmeat* | *Scientific Applications on Linux* | *National Technology Transfer Center* | *National HPCC Software Exchange* | *Netlib* | *Savannah* | *Space Telescope Science Institute* | *Astronomical Software and Documentation Service* |
|---|---|---|---|---|---|---|---|---|---|---|
| Domain | General | General | General | Scientific | Federal technologies (mostly NASA) | HPPC | Mathematics | General | Astronomy | Astronomy |
| Type of Assets | Applications and source code | Open source applications | Open source applications | Tools and packages with source code | Applications | Tools and end packages | Source codes | Tools and packages | Packages, source | Packages, source |
| Register User | ★★★ | ★★★ | ★★☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ★★☆ | ☆☆☆ | ☆☆☆ |
| Contribute/Update Assets | ★★☆ | ★★★ | ★★☆ | ☆☆☆ | ★☆☆ | ☆☆☆ | ★★☆ | ★★☆ | ☆☆☆ | ★★☆ |
| System Feedback | ★☆☆ | ★☆☆ | ★★☆ | ☆☆☆ | ★★☆ | ☆☆☆ | ★★☆ | ★★☆ | ★★☆ | ★★☆ |
| Automatic Notifications | ★★☆ | ★★☆ | ★★☆ | ☆☆☆ | ★★☆ | ☆☆☆ | ☆☆☆ | ★★☆ | ☆☆☆ | ☆☆☆ |
| Discovering Assets | List, Hierarchy, Search | Hierarchy, Search | Hierarchy, Search | Hierarchy, Search (broken) | List, Hierarchy, Search | Hierarchy, Search | Hierarchy, Search | List, Search | List, Hierarchy | List, Hierarchy, Search |
| Register Asset Usage | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ |
| Provide Asset Review | ☆☆☆ | ★☆☆ | ★★★ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ | ☆☆☆ |
| Monitoring Feedback | ★★☆ | ★★☆ | ★★☆ | ☆☆☆ | ★☆☆ | ☆☆☆ | ★☆☆ | ★★☆ | ★☆☆ | ★☆☆ |
| Secure Log In / Registration | YES | YES | NO | N/A | N/A | N/A | N/A | YES | N/A | N/A |
| Catalog or Repository | Repository | Repository | Repository | Catalog | Both? | Catalog | Repository | Repository | Repository | Catalog |
| Operation Support | Medium | Large | Medium | Inactive | Uncertain | Inactive | Large | Large | Small | Medium |
| Technology | PHP, MySQL | PHP | XML-RPC | HTML, Java | ASP | Repository In a Box | HTML | Perl, PHP, MySQL | HTML | HTML |

# Study Conclusions

- A domain-specific catalog/repository system is needed to encourage and better enable software reuse within the community of Earth science software developers.
- Some collaboration with existing systems may be possible, but existing systems alone cannot meet the needs of our community.
- Existing tools like the SourceForge software can be used in developing a reuse enablement system.
- Existing domain-specific reusable artifacts in other catalogs and repositories can be linked to by the RES.

# Planned RES Structure

A web interface will provide users with easy access to the system.




Customized components will be used to provide functionality beyond what the base system provides.

*Goal is to provide a catalog/repository system that is easy to use by reusing existing components and building off of them as needed.*

SourceForge, Savane, GForge, Repository In a Box, or a similar product will provide much of the required functionality.

# Planned RES Features (1)

- The system will host or link to reusable software assets, typically source code, tools, and applications.
- Assets will be uploaded to the system through the web-based interface.
  - Registration as a “provider” will be required to upload assets
- Providers will be able to update assets in the system, but major changes may require administrator approval to ensure the asset is still relevant to the community.
- Metrics tracked will include number of downloads per asset and number of users who register their active use of an asset.
  - Downloading does not guarantee active usage, which is the more important measure for software reuse.

# Planned RES Features (2)

- The system is expected to be as automated as possible so that the support required is minimal.
  - Some level of support will be available to users.
- Ratings and reviews features will allow users to provide feedback about assets to the creators and other users.
  - A form of peer-review
- A number of other issues will be addressed as the planning of the RES continues, including
  - Tools used and supported
  - Protection of data rights and intellectual property
  - Classification of assets

# Next Steps

- An architecture study is planned to select the most suitable base system for use in the RES.
  - System requirements will be revisited as planning and development continues, and revised if necessary
  - Prototype systems will be created and tested as part of the selection process
  - Additional functionality, such as services, will also be added in the future
- Policy related issues (e.g., how to handle misuse of the ratings/reviews feature) will be considered and addressed in conjunction with the architecture study.
- Implementation of the actual RES would take place after the architecture study (planned for completion this year).

# Reuse WG Contacts

- Software Reuse Portal Web Site
  - http://softwarereuse.nasa.gov/
- Co-chairs
  - Vic Delnore <v.e.delnore@nasa.gov>
  - Robert Wolfe <robert.e.wolfe@nasa.gov>
- Mailing List
  - Ryan Gerard <ryan.gerard@gsfc.nasa.gov>
- Other Information
  - Jim Marshall <james.marshall@gsfc.nasa.gov>

# Backup Slides

# System Requirements

- The Reuse Working Group collaborated for several months in 2004 to identify the important functional requirements needed for a Reuse Enablement System (RES), as illustrated in the figure.
- Additional functional requirements:
  - Minimal Operation Support
  - Performance
  - Security
  - Technology
- Important non-functional requirements:
  - Domain (Earth science focus)
  - Type of assets provided (small-sized components)
- Primary users of a RES are NASA-funded software developers within the Earth science community who create software products.